

Technology Innovation Project



Project Brief

TIP 256: EPRI Strategic and Flexible Transmission Planning

Context

The coming years are expected to bring greater uncertainty with regard to fuel mix, location of resources, plant retirement, demand, and increased variability caused by wind and solar generation. In planning future systems, these uncertainties need to be taken into account to ensure robust plans that can adapt to different possible outcomes. Transmission planning will need to ensure adequate reliability while minimizing expected costs to the consumer in the context of this uncertainty. In addition, system planners need to ensure there is sufficient flexibility in the system to respond to increased variability due to wind, photovoltaic, and demand response. Planners must also be able to consider how changes in operation of the system can impact on the need for flexibility.

Description

In 2011 and 2012, this project had two separate pieces. One demonstrated transmission planning that considers both economic and reliability aspects in one process. The other developed a framework for the evaluation of system flexibility to respond to increased ramps in net demand caused by an increase in variable generation. From 2013, this project will focus around a framework to assess system flexibility needs and resources.

In systems with high variability and uncertainty, flexibility must be included in the planning process to meet reliability targets, in terms of responding to changes in net load and to reduce the cost impacts of integrating large amounts of variable generation (VG); more flexible systems should reduce the impacts of VG. This should be balanced against the fact that flexible resources tend to be more expensive.

The work on flexibility will include ensuring that transmission is considered in conjunction with measuring flexibility adequacy and the ability of newer resources such as demand response and storage to offer flexibility. Flexibility metrics will be proposed to ensure flexibility adequacy in systems aiming for high penetrations of VG. These will be based on simple screening level approaches using basic system data as well as detailed production simulation based approaches.

In addition to the issue of system flexibility, work done in 2011 and 2012/early 2013 examined how transmission planning could balance reliability and economics in decision making. Current planning processes perform an

economic evaluation of a proposed project as a separate step following the reliability assessment. An integrated framework would consider both together. Case studies were used to demonstrate ideas in this work, which employed a probabilistic transmission planning tool.

Continued work will provide information for members to start applying the methodologies developed in their own planning process. By properly considering flexibility, along with capacity, planners should be able to make more optimal decisions about transmission project location and justification, generation expansion and other system planning issues. Existing planning tools can be altered using the proposed framework to consider reliability and economics incorporated into the planning process together with metrics on flexibility needs and sources.

Why It Matters

This project will provide numerous benefits to power system development. In particular, it should allow better planning decisions how best to use transmission and generation resources to maximize the value of flexible grid resources, and consider flexibility adequacy in planning for systems with high penetrations of wind/PV. Key benefits will include the following:

- Metrics to determine the flexibility needs and resources in a system, considering new and existing flexibility resources as well as the impact of the transmission network in a system. The case studies on flexibility requirements will demonstrate the framework developed which includes a screening tool as well as detailed production cost simulations.
- The case studies on transmission planning can be used in applying the developed value-based planning framework such that reliability and economics are balanced while making prudent planning decisions. These results can assist transmission planning better navigate through the challenges in proposing an optimal transmission plan.
- Identification of the proper consideration of flexibility in system resource planning by using case studies to show the value of flexibility. This includes a better understanding of the flexibility offered by demand response and how this compares with other flexible resources in managing variability and uncertainty.

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Goals and Objectives

The overall objective of this project is assisting system planning from both the resource side as well as the transmission side. The System Flexibility Screening Tool will allow for easier analysis of flexibility requirements and flexibility resources for systems with high levels of variable generation. Using easily obtainable system-level data about the system of interest, this tool allows the user to produce metrics about system variability, and to identify the need for further study. The flexibility of the system in dealing with minimum load and with ramping at different times of day will be shown. In addition, the detailed flexibility metrics will allow for consideration of the flexibility sufficiency of a system, including how transmission impacts on the system flexibility metrics, and how different resources can improve system flexibility. The framework developed in 2011/2012 using value-based probabilistic planning can be used to balance reliability worth and economic worth of a transmission system plan. The overall goal of this project is to examine how transmission expansion and flexibility requirements can be included in a planning framework. While the balancing reliability and economics portion has been completed in this project, it is expected that lessons learned there will be included in the flexibility planning framework.

Deliverables

- Simple method to analyze variability of the system and understand flexibility requirements, with illustrative figures and ability to export data to Excel.
- Set of standardized flexibility adequacy metrics based on both simplified screening analysis and on detailed simulation/historical data .
- Identification of periods of highest variability and possible flexibility deficits using easily obtainable data
- Detailed simulations using production cost techniques to demonstrated flexibility adequacy metrics and examine how different operational assumptions can impact on system flexibility
- Algorithms to examine how to consider flexibility in resource adequacy assessments.
- Realistic Transmission System Case Study report demonstrating the application of the framework to balance reliability and economics in transmission planning decisions

Project Start Date: January 1, 2012

Project End Date: December 31, 2016

Reports & References (Optional)

Links (Optional)

Participating Organizations

EPRI

Funding

Total Project Cost:	\$2,231,066 (5 yrs)
BPA Share:	\$58,371 (per yr)
External Share:	\$2,172,695
BPA FY2013 Budget:	\$58,371

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